Exemption No. 7120

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98055-4056

In the matter of the petition of

Bombardier Completion Centre, Inc.

For an exemption from § 25.785(b) of
Title 14, Code of Federal Aviation Regulations

Regulatory Docket No. 29820

PARTIAL GRANT OF EXEMPTION

By letter dated July 19, 1999, Michel Rousseau, Aircraft Certification Engineer, Quebec Region, Transport Canada, Transport Canada Center, 700 Leigh Capreol, Dorval, Quebec, Canada, H4Y 1G7, petitioned on behalf of Bombardier Completion Centre Inc., the Federal Aviation Administration, for an exemption from § 25.785(b) Title 14 Code of Federal Regulations (14 CFR). The proposed exemption, if granted, would permit relief from the general occupant protection requirements for multiple place side-facing seats on BD700-1A10 Global Express airplanes.

The petitioner requests relief from the following regulation:

> Section 25.785(b), Amendment 25-64, requirements for general occupant protection for occupants of multiple place side-facing seats that are occupied during takeoff and landing.

The petitioner's supportive information is as follows:

> "The purpose of this letter is to request an exemption to FAR 25.785(b), covering occupant general injury criteria, to permit the installation of side-facing seats manufactured by BE-AMP in any BD700-1A10 Global Express aircraft used for

corporate transport. These side-facing seats would be approved for occupancy during taxi, take-off, and landing, in accordance with FAR 25.562 plus the additional requirements deemed necessary by the Authorities and specified in FAA documents. This exemption would only be applicable to BD700-1A10 airplanes operated on the U.S.A. register with the proposed side-facing divan installed. The same exemption has been requested from Transport Canada in a letter, [to Transport Canada, M. Rousseau, dated 13 July, 1999, from BCCM (Bombardier Completion Centre) B. Kmieciak] for aircraft operated on the Canadian register.

"DISCUSSION

"The primary function of side-facing seats/divans is to provide berthing during flights of long duration where, typically, the corporate airplane operates at less than full occupancy. However with a larger compliment of passengers or when the divan area is required as a conference area, then there is a need for them to be available for occupancy during taxi, take-off, and landing. Thus it is essential for the side-facing seat to be made acceptably safe so as to enable its use under any flight condition. The dynamic testing requirements of FAR 25.562 plus specific additional requirements increase those challenges significantly. The main concern is the manner in which the occupants of side-facing seats load the seat and how well they are retained by the seat and the restraint system.

"FAA Memorandum, 'Side-facing Seats on Transport Category Airplanes', dated 19 November 1997, and the FAA 'Draft Issue Paper', dated 12 November 1997, pertain to side-facing divan seats. These documents specify limits for occupant protection criteria for side-facing seats that are additional to those required by FAR 25.562 for seating in general. The memorandum and Issue Paper introduce requirements for body to body contact, TTI, and lateral pelvic acceleration, which are additional to the existing FAR 25.562(c) HIC requirement. The specified conditions are required to be measured during side-facing seat tests and the limitations respected. The Issue Paper further requires that a divan tested to these requirements and meeting TSO C127a may only be installed in an aircraft by exemption to FAR 25.785(b).

"JUSTIFICATION & SAFETY CONSIDERATIONS

"The proposed BE-AMP divan consists of two components, a single seat unit, and a double seat unit. The divan units are designed to provide a body to body spacing that is known to preclude contact even when they are used in combination. Photometric data from a test conducted on a two seat side-facing divan show that body to body contact does not occur.

"The proposed BE-AMP side-facing divan is to be certified to a combination of the requirements of FAR 25.562, the Issue Papers, and Memorandum. The dynamic tests specified in these documents have been performed successfully for the divan in free

space. As part of those tests, the Occupant Movement Envelope (OME) required for free movement of the head and torso of the forward occupant, when subjected to the 16g pulse, was measured. The OME will be used to establish a 'keep out zone' for furnishings or structures of any sort. At the same time body to body clearance was demonstrated, HIC, femur loads, lumbar loads, and belt loads, were measured, recorded and shown to be within the limits.

"As a clear zone was to be established as part of the test, the TTI measurement was not included in the data recording for these tests. The tests were performed with a life-raft and life-jackets mounted in their stowage pouches. Post test removals were performed successfully. The divans were ballasted to represent the maximum weight allowed for each divan unit.

"The result of the test program was proof of compliance with the FAA side-facing seat requirements contained in the Issue Paper, Policy Letter, and FAR 25.562, as applicable to the Global Express aircraft. This translates into a level of safety for side-facing divans in excess of that available in any other current aircraft designed specifically for corporate operation.

"ISSUE OF PUBLIC INTEREST

"The Bombardier Aerospace Group is a major international corporation that provides business aircraft to an international market. They manufacture principally in the U.S.A. and Canada and, therefore, employ a large staff in both countries. The aircraft manufactured by Bombardier are equipped with avionics and other specialised systems and equipment manufactured in North America. Bombardier provides competition in the corporate aircraft market to manufacturers in Europe and elsewhere and supports considerable employment in North America as a result. The rapid growing numbers of Transport Category corporate aircraft existing and predicted, must be designed, built, crewed, and maintained, mostly in North America. Maintaining the marketing edge requires that provision of the features required by operators, for example, the side-facing divan. Doing this without compromising safety, can only increase the sales volume of such aircraft. Therefore the stabilising effect that the manufacture and support of corporate aircraft has on the job market, is significant, and is obviously, and definitely, in the public interest of both countries.

"These aircraft will never be operated in scheduled service in this configuration nor will they ever carry average naïve airline passengers. Nor can a divan tested as specified above affect the safe operation of an aircraft in any way. Therefore the side-facing divan can have no adverse effect upon the travelling public, nor the public at large.

"CONCULSION

"BCCM believes that the above arguments favor an exemption to permit the installation of the specified side-facing seat in the BD700-1A10. BCCM respectfully requests that the FAA review the above request, and based upon the successful testing described above, issue the exemption to FAR 25.785 (b) as requested."

A summary of the petition was published in the Federal Register on December 6, 1999 (64 FR 68193). No comments were received.

The Federal Aviation Administration's analysis/summary is as follows:

Background

The applicant's petition for exemption from § 25.785(b) is based on the FAA Memorandum, Side-Facing Seats on Transport Category Airplanes, dated November 19, 1997. This memorandum provides dynamic test condition requirements and pass/fail criteria for side-facing seats on transport category airplanes.

The FAA Memorandum: Side-Facing Seats on Transport Category Airplanes, dated November 19, 1997, provides:

(1) The dynamic test conditions criteria. In terms of both pulse severity and types of tests currently required, these criteria are also considered directly applicable to side-facing seats. While it is true that the regulation was written with forward- and aft-facing seats in mind, the orientation of the seat does not change the relevant test conditions.

(2) The pass/fail criteria. For these criteria, however, the orientation of the seat may be significant. Injury criteria are currently limited to head, spine, and femur loads. Head impact is evaluated for contact experienced by the head against any aircraft interior installations, and the pass/fail criterion is based on the resultant head acceleration considering all axes of head motion. The lumbar spinal load is an axially compressive load that is primarily evaluated during the 14g, 60 degree test. The femur load is also compressive, and actually has not proved to be critical thus far. For a side-facing seat, other injury parameters may predominate such that evaluation of those parameters may be necessary to provide an acceptable level of safety.

The first consideration for a side-facing seat is the isolation of one occupant from another. That is, occupants should not rely on the impact with other occupants to provide energy absorption; body-to-body impacts are considered unacceptable.

The second consideration for a side-facing seat is the retention of occupants in the seat and restraint system. Addressing this concern may necessitate providing a means of restraint for the lower limbs as well as the torso. Failure to limit the forward (in the airplane's coordinate system) travel of the lower limbs can cause the occupant to come out of the restraint system or produce severe injuries due to the resulting position of the restraint system, and/or twisting (torsional load) of the lower lumbar spinal column.

The third consideration for a side-facing seat is limiting the load in the torso in the lateral direction, where human tolerance differs from that for the forward- or aft-facing directions and where potential injury mechanisms exist. The automotive industry has developed test procedures and occupant injury criteria appropriate for side impact conditions. Their criteria involve limitation of lateral pelvic accelerations and use of the human tolerance parameter "Thoracic Trauma Index," which is defined in 49 CFR § 571.214. Use of the 49 CFR § 572, subpart F, Side Impact Dummy (SID), rather than the 49 CFR § 572, subpart B, Hybrid II Dummy used in the 14 CFR § 25.562 test, is required to evaluate these parameters. This is the best means available, at present, to assess the injury potential of a sideward impact condition. Such an evaluation is considered necessary to provide an acceptable level of safety for these types of seats.

Other potential injury mechanisms appropriate for aircraft seats may exist. However, due to the lack of useful injury criteria for those other potential injury parameters, such as neck loads and lower limb flail, the FAA is not able to specify criteria applicable to those areas at this time. The FAA considers that such criteria may be appropriate, particularly for multiple occupancy installations, and intends to pursue their further development.

For multiple occupancy seating, the best criteria currently available cannot be said to provide an equivalent level of safety for those occupants. Therefore, the only vehicle available for accepting these installations would be through an exemption from the general occupant protection requirements of § 25.785(a) prior to Amendment 25-72, or § 25.785(b) after Amendment 25-72.

The following summary of the criteria from the FAA Memorandum, Side-Facing Seats on Transport Category Airplanes, dated November 19, 1997, provides the basis of the petition for exemption.

1. Proposed Injury Criteria

(a) Existing Criteria: All injury protection criteria of § 25.562(c)(1) through (c)(6) apply to the occupants of side-facing seating. Head injury criteria (HIC) assessments are only required for head contact with the seat and/or adjacent structures.

(b) Body-to-Body Contact: Contact between the head, pelvis, or shoulder area of one seated Anthropomorphic Test Dummy (ATD) on the adjacent seated ATD's is not allowed during the test conducted in accordance with § 25.562(b)(1) and (b)(2). Incidental contact of the legs, feet, arms and hands that will not result in incapacitation of the occupants is acceptable. Contact during rebound is allowed.

(c) Body-to-Wall/furnishing Contact: If the sofa is installed aft of a structure such as an interior wall or furnishing that may contact the pelvis, upper arm, chest, or head of an occupant seated next to the structure, then a conservative representation of the structure and its stiffness must be included in the tests. The contact surface of this structure must be covered with at least two inches of energy absorbing protective foam, such as ensolite.

(d) Thoracic Trauma: Testing with a Side Impact Dummy (SID), as defined by 49 CFR part 572, subpart F, or its equivalent, must be conducted and Thoracic Trauma Index (TTI) injury criteria acquired with the SID must be less than 85, as defined in 49 CFR part 572, subpart F. Side impact dummy TTI data must be processed as defined in Federal Motor Vehicle Safety Standard (FMVSS) part 571.214, section S6.13.5.

(e) Pelvis: Pelvic lateral acceleration must not exceed 130g. Pelvic acceleration data must be processed as defined in FMVSS part 571.214, section S6.13.5.

(f) Shoulder Strap Loads: Where upper torso straps (shoulder straps) are used for sofa occupants, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.

2. General Guidelines

(a) All side-facing seats require end closures.

(b) All seat positions need to be occupied for the longitudinal tests.

(c) For the longitudinal tests, conducted in accordance with the conditions specified in § 25.562(b)(2), a minimum number of tests will be required as follows:

(1) One test will be required with one SID ATD in the forward most position and Hybrid II ATD(s) in all other positions, with undeformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls).

(2) One test will be required with one SID ATD in the center seat and Hybrid II ATD(s) in all other positions, with deformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls). This could be considered the structural test as well.

(d) For the vertical test, conducted in accordance with the conditions specified in § 25.562(b)(1), Hybrid II ATD's will be used in all seat positions.

The FAA may refine the compliance criteria for multiple occupancy side-facing seating to establish an equivalent level of safety. This may include additional injury criteria related to neck loads or other injury mechanisms. The guidance will be updated accordingly, and the certification of multiple occupancy seating may be processed with special conditions in lieu of exemptions. Therefore, the FAA does not agree with the petitioner's request for exemption for all Bombardier Global Model BD-7001A10 airplanes. The FAA will grant an exemption that will cover airplanes that are manufactured for a specific amount of time. During this time, the FAA may refine the compliance criteria for multiple occupancy side-facing seating.

For the purposes of this petition, the date of manufacture is considered to be the date on which inspection records show that an airplane is in a condition for safe flight. This is not necessarily the date on which the airplane is in conformity with the approved type design, or the date on which a certificate of airworthiness is issued. It could be earlier, but would be no later, than the date on which the first flight of the airplane occurs.

In consideration of the foregoing, I find that a grant of exemption is in the public interest and will not affect the level of safety provided by the regulations. Therefore, pursuant to the authority contained in § 49 U.S.C. §§ 40113 and 44701, delegated to me by the Administrator (14 CFR 11.53), Bombardier Completion Centre, Inc. is hereby granted an exemption from the requirements of § 25.785(b), for the general occupant protection requirements for occupants of multiple place side-facing seats that are occupied during takeoff and landing for Bombardier Global Model BD-7001A10 airplanes manufactured prior to January 1, 2004.

The following limitations apply to this exemption:

1. Existing Criteria: All injury protection criteria of § 25.562(c)(1) through (c)(6) apply to the occupants of side-facing seating. The HIC assessments are only required for head contact with the seat and/or adjacent structures.

2. Body-to-Body Contact: Contact between the head, pelvis, or shoulder area of one Anthropomorphic Test Dummy (ATD) on the adjacent seated ATD's is not allowed during the test conducted in accordance with § 25.562(b)(1) and (b)(2). Incidental

contact of the legs, feet, arms and hands that will not result in incapacitation of the occupants is acceptable. Any contact between adjacent ATD's is acceptable during rebound.

3. Body-to-Wall/Furnishing Contact: If the sofa is installed aft of a structure such as an interior wall or furnishing that may contact the pelvis, upper arm, chest, or head of an occupant seated next to the structure, then a conservative representation of the structure and its stiffness must be included in the tests. In most cases, the representation of the structure would be more rigid and have less deflection under load than the actual installation on the airplanes. The contact surface of this structure must be covered with at least two inches of energy absorbing protective foam, such as ensolite.

4. Thoracic Trauma: Thoracic Trauma Index (TTI) injury criteria must be less than 85, as defined in 49 CFR part 572, subpart F. Thoracic trauma index data must be processed as defined in Federal Motor Vehicle Safety Standard (FMVSS) part 571.214, section S6.13.5.

5. Pelvis: Pelvic lateral acceleration must not exceed 130g. Pelvic acceleration data must be processed as defined in FMVSS part 571.214, section S6.13.5.

6. Shoulder Strap Loads: Where upper torso straps (shoulder straps) are used for sofa occupants, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.

7. Seat Positions: All seat positions need to be occupied by ATD's for the longitudinal tests.

8. End Closures: All side-facing seats require end closures or other means to prevent the occupant from translating off of the seat.

9. Longitudinal Tests: For the longitudinal tests conducted in accordance with the conditions specified in § 25.562(b)(2), a minimum number of tests will be required as follows:

> a. One test will be required with ATD's in all positions, with undeformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls). For configurations with a wall or bulkhead immediately forward of the forward seat position on the sofa, a SID ATD will be used in the forward seat position and a Hybrid II ATD(s)

or equivalent will be used for all other seat locations. For configurations without a wall or bulkhead immediately forward of the forward seat, Hybrid II ATD's or equivalent will be used in all seat locations.

b. One test will be required with Hybrid II ATD's or equivalent in all positions, with deformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls). This could be considered the structural test as well.

10. Vertical Test: For the vertical test, conducted in accordance with the conditions specified in § 25.562(b)(1), Hybrid II ATD's or equivalent will be used in all seat positions.

Issued in Renton Washington, on February 15, 2000.

/s/ Donald L. Riggin
Donald L. Riggin
Acting Manager
Transport Airplane Directorate
Aircraft Certification Service, ANM-100